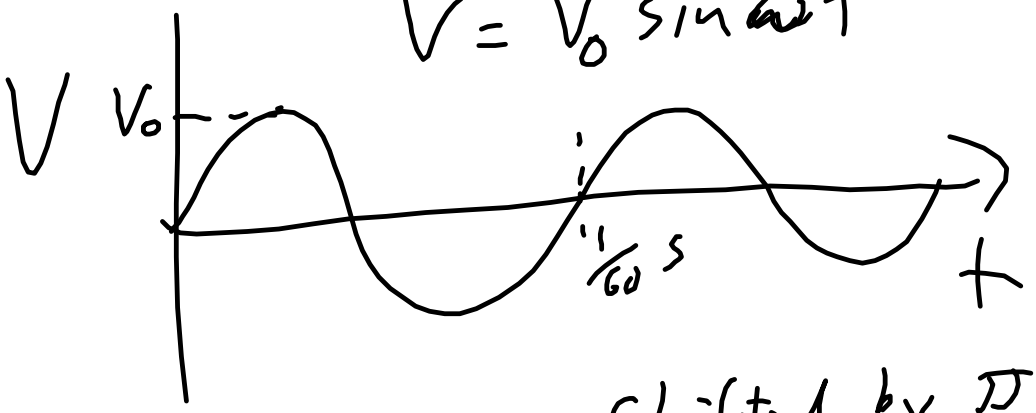
Recap AC, Kirchhoff's Laws, Internal Resistance

Alternating Current, AC

$V = V_0 \sin \omega t$



shifted by $\frac{\pi}{4}$

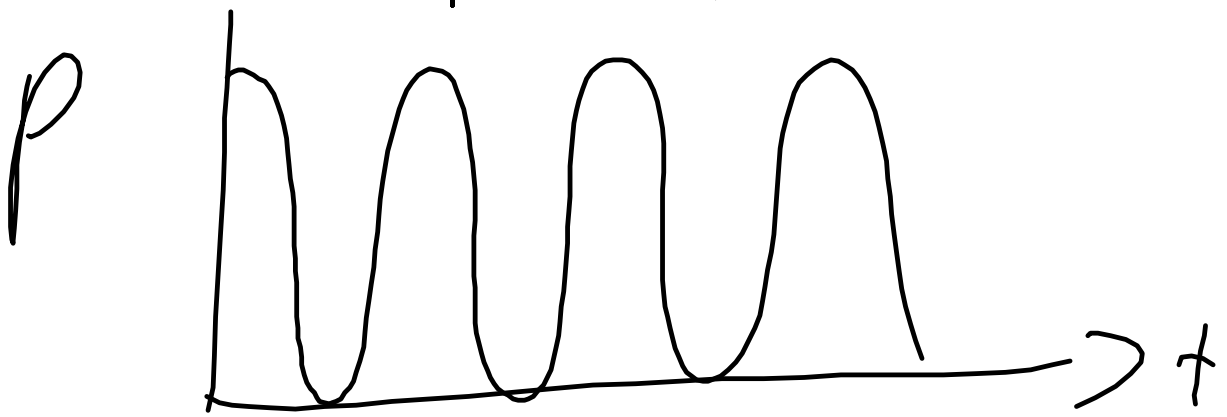
$I = -I_0 \cos \omega t$

$V_{rms} = \frac{V_0}{\sqrt{2}}$ $\quad I_{rms} = \frac{I_0}{\sqrt{2}}$

↑ root mean square

$P = VI$

$$P = P_{max} \sin^2 \omega t$$



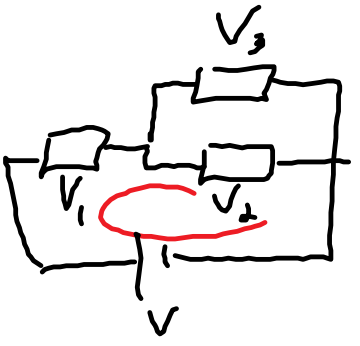
$P_{max} = V_0 I_0$ $\quad$ $P_{avg} = V_{rms} \times I_{rms}$

$$\bar{P} = \frac{V_0}{\sqrt{2}} \frac{I_0}{\sqrt{2}}$$

$$\bar{P} = \frac{V_0 I_0}{2} = \frac{P_{max}}{2}$$

Kirchhoff's Laws

Loop law, KLL



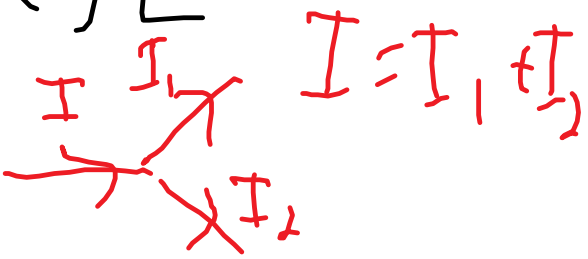
ΣV around a loop $= 0$ $\quad V_2 = V_3$

$V = V_1 + V_2$

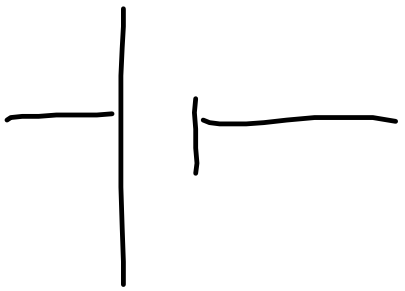
$V = V_1 + V_3$

Junction Law, KJL

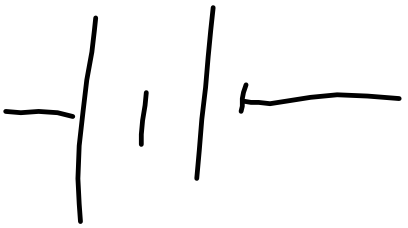
$I_{in} = I_{out}$



Symbols:



Cell

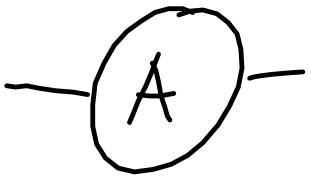


battery

ac supply

Switch

Galvanometer



Ammeter

*

must be in Series

Voltmeter

*

Put in Parallel across element

Galvanometer - small currents

Series

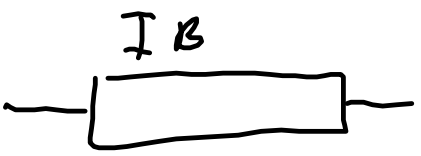
- replaces a wire

ideal $r = 0$

across element you are measuring

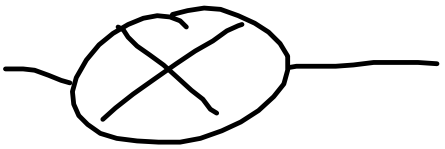
ideal $r = \infty$

resistor



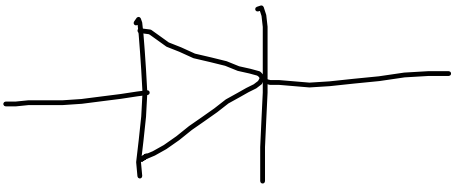
bulb

lamp

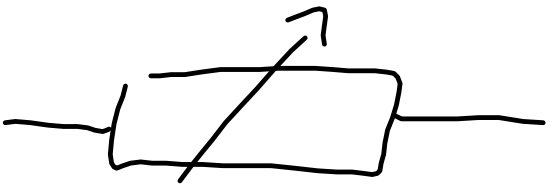


buzzer

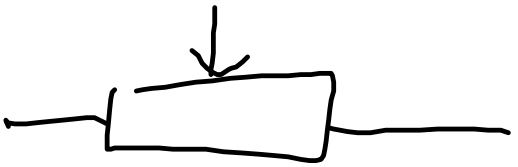
diode



variable resistor

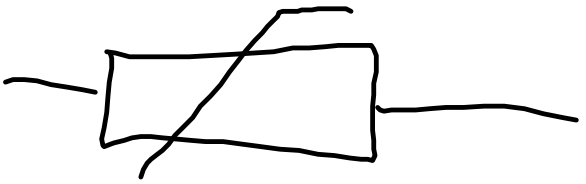


potentiometer

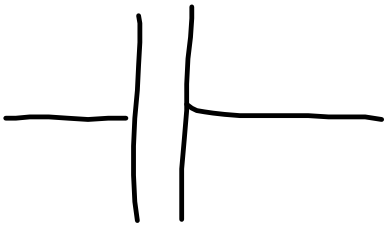


light-dependent resistor

thermistor

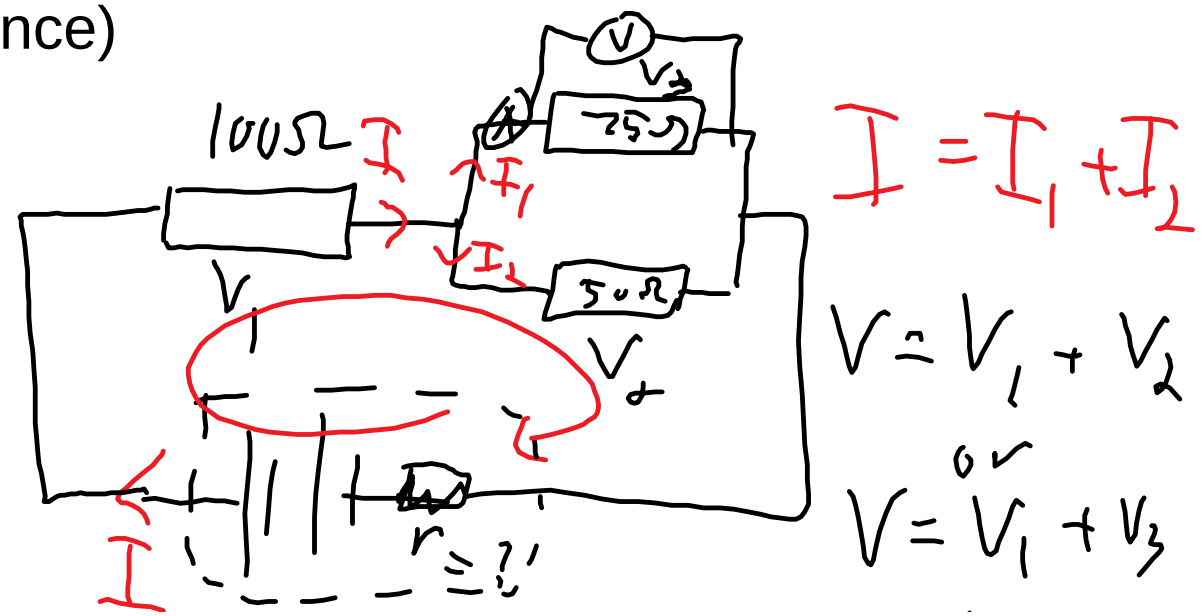


capacitor



A 8.0v battery is connected to a 100 ohm resistor then the wire splits into a 75 ohm and 50 ohm resistor (in parallel to each other) and join up back to the battery.

a) Draw the circuit diagram, showing the location of a voltmeter and ammeter to measure the properties of the 75 ohm resistor.
b) What is the equivalent resistance?
c) What is the current out of the battery?
d) What are the values registered on the ammeter and voltmeter?
e) Which resistor dissipates the most power?
f) If the current through the 75 ohm resistor is only 13mA, determine the internal resistance of the battery.
g) If a 6.0 V batter is placed in series with the 75ohm resistor reverse polarized (positive towards positive) - determine the current through the 50 ohm resistor. (ignore internal resistance)



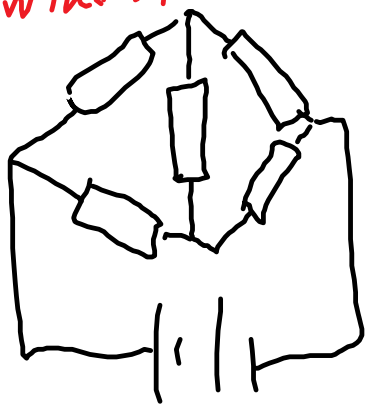
$V = 8.0V$

Series

$$R_T = R_1 + R_2$$

$$P = P_1 + P_2 + P_3$$

Wheatstone Bridge



Parallel

$$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2}$$

$$\frac{1}{R_{Total}} = \frac{1}{50} + \frac{1}{75} = \frac{3}{150} + \frac{2}{150}$$

$$R_{T_1} = 30\Omega$$

$$R_T = 30\Omega + 100\Omega = 130\Omega$$

$$I = \frac{V}{R_T} = \frac{8.0V}{130\Omega} = \boxed{62mA}$$